AUTOMATED SCRIPT GENERATION TO UPDATE DATABASES

Technical Field

This invention generally relates to cellular communications. More particularly, the present invention relates to generating a script to update cell site information in a database.

Background of the Invention

With the increasing popularity of cellular phone communications, managing the data associated with calls to and from cellular phones has become increasingly complex. For example, some of this data is cell face transfer data. Cellular phone systems typically include a cell face (or antenna) mounted on an antenna tower receiving calls from cell phones. Typically, a cell face receives calls within an associated geographic coverage area called a cell. An antenna tower can have multiple cell faces oriented at different angles to handle calls originating from multiple directions around the antenna tower. A process is employed in order to choose a cell face that handles the call from each cell phone. The process of selecting and switching among cell faces involves the use of data that designates available cell faces. A neighbor list in the database specifies all the neighbor faces to which the current call can be handed off to. Before handing a call to a neighbor cell face, signal strength from all the neighbor faces are measured and the cell

face with the strongest signal strength is designated for handoff. For example, as a mobile call moves away from one cell face, the neighbor list is accessed to select another cell face that is closer to the call so that the call can be handed off to the closer cell face.

The neighbor list data and numerous other types of data (such as data pertaining to cells, Channel Data, Trunk Group and Member data, Device data, etc.) may be stored in a database of a cellular network, such as one manufactured by Ericsson. Making changes to data in one of these databases in the cellular network may be complex. For example, typically an operating system in the cellular network is used to access a command handler application. The command handler application accepts line commands and performs updates and revisions to the database based on these line commands.

One problem with these line commands is that they are not intuitive to a user. Thus, a user must be familiar with specific line commands in order to enter the correct line commands and make the proper updates and revisions. When a lot of updates need to be made to the database, manually using line commands is time-consuming and also error prone because the risk of a mistake increases. Thus, there is a need for automating the update process of these databases to decrease the amount of time required to perform database updates and also decrease the number of errors made in updating these databases.

Summary of the Invention

Cellular site information is often stored in databases, such as a database manufactured by Ericsson. Updating this cellular site information is often difficult because specific line commands, or scripts, must be entered into a command handler application. Thus, one problem with updating cellular site information is that a specific knowledge of these line commands is necessary to make changes to the cellular site information databases. Another problem is that even if a user has knowledge of the required line commands, the user, when making multiple changes to the database, may make mistakes. Thus, the present invention, in one embodiment, automates the script generation process to eliminate the need for knowledge of specific line commands and to

reduce the number of errors made.

In one embodiment, the invention is an automated script generation method to update databases in a cellular system. Using an update application program, a user inputs a field of a cellular site information database that is to be modified. An update skeleton script is generated including all of the line commands necessary to update the field. The skeleton script is a file containing line commands to be executed. The skeleton script does not include device values or field values. The device values and field values are input by the user. An input file is generated by the user including the device that is to be changed and what the value of the identified field is to be changed to. The skeleton script is populated with the data from the input file to create a finalized script. The finalized script is run by a command handler application program to update the database.

These and other features, advantages, and aspects of the present invention may be more clearly understood and appreciated from a review of the following detailed description of the disclosed embodiments and by reference to the appended drawings and claims.

Brief Description of the Drawings

Figure 1 is an exemplary cellular operating environment implementing an embodiment of the present invention.

Figure 2 is a multiple cell operating environment implementing an embodiment of the present invention.

Figure 3 is a diagram illustrating a cellular processor including a forms database.

Figure 4 is a flow diagram illustrating a method for updating a cellular site database in accordance with an embodiment of the present invention.

Detailed Description

In one embodiment, the present invention is an automated script generation method to update databases in a cellular system. Using an update application program, a user inputs a field of a cellular site information database that is to be modified. An update skeleton script is generated including all of the line commands necessary to update

the field. The skeleton script is a file containing line commands to be executed. The skeleton script does not include device values or field values. The device values and field values are input by the user. An input file is generated by the user including the device that is to be changed and what the value of the identified field is to be changed to. The skeleton script is populated with the data from the input file to create a finalized script. The finalized script is run by a command handler application program to update the database.

Having briefly described an embodiment of the present invention, an exemplary operating environment for the present invention is described below in reference to Figure 1. Referring now to the drawings, in which like numerals represent like elements throughout the several figures, aspects of the present invention will be described.

Figure 1 illustrates a suitable operating environment **200** utilizing an embodiment of the present invention. The environment **200** is generally a cellular telephone system for receiving and transmitting cellular phone calls. A cellular phone **202** is transmitting a signal **204** within a cell **206**. The cell **206** is a geographic area generally defined by a boundary **208**. The cell includes an antenna tower **210** that has transmitters and receivers for transmitting and receiving signals. The transmitters on the antenna tower **210** transmit at a designated power level. Likewise, the cell phone **202** transmits the signal **204** at a designated power level. The designated power levels of the antenna tower transmitters and the cell phone **202** dictate the location of the boundary **208** of the cell **206**. Receivers on the antenna tower **210** will generally receive the signal **204** while the cell phone **202** is within the boundary **208** of the cell **206**. Generally, when the cell phone **202** leaves the boundary **208** of the cell **206**, the receiver of the antenna **210** will no longer receive the signal **204**. In one embodiment, the cell boundary **208** is substantially hexagonal in shape.

A receiver on the antenna tower **210** is generally referred to as a cell face. The antenna tower **210** may have more than one cell face, such as a cell face **212** and cell face **214**. A typical antenna tower has three cell faces, but the number of cell faces can vary.

Each cell face on the antenna tower **210** is positioned so that it covers an area within the cell **206**. Depending on the positioning and the orientation of the cell face **214**, the cell face **214** will receive calls coming from a particular direction. The cell face **212** is oriented in a different position to receive calls coming from a different direction with respect to the antenna tower **210**. A variety of cell face configurations are known in the art. For example, one cell face configuration is known as the omni face, which comprises a single cell face with a coverage area of 360° around the antenna tower. A common cell face configuration includes three cell faces with each cell face having a coverage area of 120° around the antenna tower. Typically a structure **216** is located near the antenna tower that houses communications equipment, such as radio transmitters, radio receivers, and power supplies. The communications equipment is connected to transmitters and cell faces on the antenna tower via a communications link **218**. The structure **216** and the antenna tower **210** are commonly referred to as a base station **220**. The base station **220** is located substantially in the middle of the cell **206**.

Each cell face on the antenna tower **210** has an associated transmitter. Transmitters transmit control signals on unique control channels or frequencies that are used to send control messages to the cell phone **202**. When the cell phone **202** is in operation, the cell phone **202** searches for the strongest control signal coming from the antenna tower **210**. The receiver in the cell phone **202** locks on to the strongest control channel and begins receiving control information. The control information includes the transmission frequency at which the cell phone **202** should transmit. In the exemplary environment **200**, when the cell phone **202** begins operation, it receives the strongest control signal from a transmitter associated with the cell face **214**. Thus, as depicted in Figure 1, the signal **204** from the cell phone **202** is being received by the cell face **214**. The cell phone **202** may transmit using any of a number of communications protocols known in the art. The signal **204** will follow the protocol used by the cell phone **202**. For example, the cell phone **202** may utilize an analog protocol known as advanced mobile phone system (AMPS). Alternatively, the cell phone **202** may use a digital protocol, such

as time division multiple access (TDMA).

The communications equipment **216** receives the signal **204** and may demodulate the signal. The communications equipment **216** typically is operable to receive signals in a variety of formats, including AMPS and TDMA. The signal **204** is sent to a cellular processor **222** via a communications link **224**. The cellular processor **222** is typically a sophisticated computing device operable to manage cellular communications at the antenna tower **210**. For example, the cellular processor **222** can monitor the signal strength of the signal **204.** Also, the cellular processor **222** can detect when the cell phone **202** has been disconnected to terminate the call **204**. The cellular processor **222** may also facilitate billing and locating the cell phone **202**. One example of a cellular processor known in the art is the Executive Cellular Processor (ECP) manufactured by Lucent. Many other cellular processors are known in the art. The cellular processor **222** utilizes a database **226** to perform its functions. One particular function that the cellular processor **222** performs is determining which of the cell faces on the antenna tower **210** should optimally be used to receive the signal **204**.

When the cell phone initially places a call **204**, the cell phone **204** may be located in the coverage area of the cell face **214**. Thus, the cell face **214** may have been optimal at the beginning of the conversation. However, the user of the cell phone **202** may be moving while the conversation is taking place. While the cell phone **202** moves in a direction **228,** the signal strength of the signal **204** will vary with respect to the cell faces **212** and **214**. The cellular processor **222** detects the variation in signal strength of the signal **204**. As the cell phone **202** moves in the direction **228**, it moves away from the cell face **214** and closer to the cell face **212**. The cellular processor **222** detects a decrease in the signal power received by the cell face **214**. Eventually, as the cell phone **202** continues to move, signal power received by the cell face **214** will be less than a minimum required level. In response, the cellular processor **222** accesses the database (neighbor or handoff list) **226** to determine which cell face the signal **204** can be transferred to.

The cellular processor **222** accesses a neighbor list in the database **226**. The neighbor list is generally a list of cell faces to which a signal may be transferred or handed off. For example, the database **226** has a neighbor list associated with the cell face **214**. The neighbor list for cell face **214** provides a list of available cell faces where the signal **204** can be transferred. In the example shown in Figure 1, the cell face **212** is among the available cell faces given in the cell face transfer data for the cell face **214**. After the cellular processor **222** identifies the cell face **212** as the optimal cell face, the cellular processor **222** sends a message to the communications equipment **216** indicating that the cell phone **202** should begin transmitting at a frequency associated with the cell face **212**. In response to a message from the cellular processor **222**, the transmitter for the cell face **214** transmits a control signal to the cell phone **202** that instructs the cell phone to switch to a frequency associated with the cell face **212**. The process of transferring the cell phone signal **204** from the cell face **214** to the cell face **212** is extremely fast. There is no break in the conversation recognizable by the user of the cell phone **202**. The process of transferring a signal from one cell face to another is referred to as handing off the Call.

In order to update database **226**, an embodiment of the present invention is running on a server **228** that is in communication with the cellular processor via a communication link **230**. The server preferably includes an update system that is accessible by a workstation **232** connected to the server via a communication link **234**. A user of the workstation **232** can access the update system running in the server **228** to facilitate updating of the database forms. Cellular processor **222** transfers the forms from the database **226** to the server **228** via the communication link **230**. The update system accesses the forms in the server **228**. The forms may include Neighbor list. However, the forms may also include other types of cell site information data such as cell information, channel information, device information, trunk group and member information, etc. The description of neighbor list is exemplary and is not meant to limit the type of cell site information that may be stored in the database.

Figure 2 illustrates an exemplary multiple cell operating environment **300** implementing an embodiment of the present invention. The environment can include one or more cells, such as cell **301**, cell **302**, cell **304**. Cells are often referred to as sites. Typically, each cell has an associated cell identification number used to identify the cell. Each cell has a base station, such as base station **306**. The cell **302** has a base station **314** and cell **304** has a base station **316**. Like the base station **220** of Figure 1, the base stations **306**, **314**, and **316** each include radio equipment and an antenna tower having one or more cell faces. Cells **301**, **302** and **304** may, but do not necessarily, overlap, as shown by an overlapping region **307**. In one embodiment, the cell **301** has a coverage area defined by a substantially hexagonal boundary **308**. During operation, a cellular processor **310** communicates with the base station **306** to monitor calls within the cell **301**. Another cellular processor **312** communicates with the base station **314** and the base station **316** to monitor calls within cell **302** and cell **304** respectively. A typical cellular processor may be associated with 100 or more cells and base stations. The environment illustrated in Figure 2 is exemplary only and the systems and methods described can generally be applied to environments including hundreds of cells.

As has been discussed, cellular processors, such as cellular processor **310** and cellular processor **312** typically monitor various data about cellular phone calls, such as signal strength, cell phone location, and billing. The cellular processors **310** and **312** also transmit signals to a mobile switching center (MSC) **318**. The MSC **318** relays cell phone signals to an external network **320**, such as a telephone wireline network. The MSC **318** is a sophisticated system that is in communication with networks and switches around the world to determine an optimal route for cell phone calls to reach their destination.

In the exemplary environment **300**, a mobile communication device, such as a cell phone **322**, is shown in the cell **301** transmitting a signal **324** to the base station **306**. The signal **324** transmits voice data over a voice channel to a cell face at the base station **306**. The base station **306** receives the signal **324** and transmits it to the cellular processor **310**

so that the cellular processor **310** can monitor the signal **324**. The cellular processor **310** may also transmit the signal **324** to the MSC **318**, which may route the signal to the external network **320**. The cell phone **322** may utilize any communications technology known in the art and the signal **324** may follow any protocol known in the art. Communications technologies include, but are not limited to, Code Division Multiple Access (CDMA), Advanced Mobile Phone System(AMPS), Global System for Mobile Communications (GSM), and Time Division Multiple Access (TDMA). Preferably, the base station **306** is operable to receive any or all of the possible communications technologies. The base station must be configured to each technology – the Radios must be analog or digital. An analog radio won't be able to handle digital calls. If the radio is a TDMA radio, it won't be able to handle GSM or CDMA calls.

As shown in Figure 2, the cell phone **322** is traveling in a direction **326**. The cell phone **322** is moving in the cell **301** toward the cell **304**. As the cell phone **322** travels, it maintains communications with the base station **306** and the cellular processor **310** monitors the strength of the signal **324**. As the cell phone **322** moves farther from the base station **306**, the cellular processor **310** may detect that the strength of the signal **324** diminishes or weakens. The cell phone **307** travels through the overlapping region **307** where cell **304** and cell **301** overlap. When the signal strength of the signal **324** drops below a minimum power level, the cellular processor **310** accesses a neighbor list in a database **328** to determine an available cell face for a hand off. The database **328** contains a plurality of neighbor lists. Each neighbor list is associated with a cell face at a cell. Preferably each neighbor list has a cell identifier and a cell face identifier for the associated cell face. The cellular processor **310** reads cell face transfer data entries from the neighbor list that identify an available transfer cell face for a hand off. Handing off a call generally means transferring the call from one cell face to another cell face.

Cell face transfer data may be updated when a new cell such as cell **304** is implemented. For example, cell **304** and its associated base station **316** may be put into service after the cells **301** and **302** are operating. When the base station **316** is put into

service, a plurality of new cell faces associated with base station **316** are made available to offer mobile communication service that was not existent prior to implementation of cell **304**. As a result of the implementation of cell **304**, data in the databases **328** and **330** may be updated to reflect the addition of cell **304**. As an example, a call in cell **301** traveling into cell **304** may be handed off to a cell face of the base station **316**. The cellular processor **312** will monitor the mobile telephone user's call for various parameters including signal strength. As the traveler travels from the cell **301** toward the cell **304**, the signal strength from the call may diminish. The cellular processor **312** will send a signal to the base station **306** to initiate a hand-off to transfer the call to a cell face of the base station **316**. The cellular processor **310** accesses the cell face transfer data stored in the database **328**. The cellular processor **310** uses cell face transfer data in the database **328** to identify cell faces that are available for the call **324** to be handed-off.

Also shown in Figure 2 is a computer **332** communicating with the cellular processor **310** and the cellular processor **312**. The computer **332** implements an update system in accordance with an embodiment of the present invention. The update system can automatically update the database **328** and the database **330**. The communications channel **334** can be any communications means known in the art. Examples of communications channels include, but are not limited to, Ethernet, telephone lines, or any proprietary communications protocol. A user of the computer **332** can select between the database **328** and the database **330**, and access the database to update forms on the database. It should be understood that, in some embodiments, the databases **328**, **330** may be located at the MSC **318**. It should also be understood that the databases **328**, **330** may include all different types of cell site information, not just cell face transfer data.

Figure 3 illustrates an exemplary cellular processor including a forms database including cell face transfer data and other types of data. A cellular processor **400** is depicted having memory **408** wherein database data is be stored. Memory **408** can be any form of storage media known in the art, including, but not limited to random access memory (RAM), read only memory (ROM), electronically erasable programmable read

only memory (EEPROM), or flash memory. Also, the form data base **402** can be stored on mass storage devices such as, but not limited to, CD ROM, digital versatile discs (DVD), magnetic cassettes, PCMCIA card memory, or any other medium which can be used to store the desired information and which can be accessed by the cellular processor **400**. In general, the form database **402** is a table of binary encoded data that is indexable by cell identification numbers **404**. Each cell identification number **404** can identify a physical cell site. Each cell identification number **404** may also identify a cell face of a cell. For each cell identification number **404**, a plurality of forms **406** exist in the form database **402**. Each form holds a particular kind of data associated with a given cell identification number **404**, and preferably can be viewed on a computer monitor. Example forms may include information regarding a cell such as latitude/longitude (where the cell is located), what ECP/MSC the cell belongs to, the status of the cell (equipped/unequipped), how many radios of each type the cell has, trunk groups associated with the cell, etc.

Referring now to Figure 4, a flow diagram illustrating a method 500 for updating a cellular site database in accordance with an embodiment of the present invention will be described. The method **500** begins at start step **505** and proceeds to step **510** where an input is received. The input identifies a field of a database that is to be modified. For example, the user may enter "vcg" to indicate that the user wishes to modify the voice channel group (vcg) field. It should be understood that, in a preferred embodiment of the invention, the database is a cellular site information database such as **226**, **328**, or **330**. It should also be understood that, in a preferred embodiment, the database is a cellular site information database manufactured by Ericsson. In a preferred embodiment, the present invention is an update application program that is running on server **228** and/or computer **332**. It should also be understood that an operating system for the cellular site information is running on server **228** and/or computer **332**. For example, the operating system may be the Ericsson Operation & Support System (OSS). In conjunction with the operating system for the cellular site information, a command handler application

program may also be running on server **228** and/or computer **332**. For example, the command handler may be the Ericsson command handler. A command handler is a program in which users enter line commands and have those line commands executed. A sample line command for input into the Ericsson command handler is: blodi:dev=mdvc-1001. This command when executed by the command handler will block the device "mdvc-1001" from the cellular system. Thus, in a preferred embodiment of the present invention, the user enters an input into the update application program running on the workstation **232** or computer **332** to indicate a field of the cell site information that the user wishes to modify. Another sample line command is mtclp:cell=all; this command displays all the cells in the database. The field "cell" tells the system that the user is looking for the cells. Another example is mbtcp:ceq=mbceq-001 which illustrates the CEQ (Channel Equipment) to MBTPT (another device) connection. The method then proceeds to step **515**.

At step **515**, a skeleton script is generated including the line commands necessary to update the field identified at step **510**. The skeleton script is a file containing line commands to be executed. However, the skeleton script does not include device values or field values which are input by the user as will be described below. In one embodiment of the invention, a lookup table is used to find the skeleton script based on the input received at step **510**. For example, whenever the user enters the "vcg" field, then a particular skeleton script is used and whenever the user enters another field another skeleton script may be used. The method then proceeds to step **520**.

At step **520**, an input file is generated including the device that is to be changed and what the value of the identified field is to be changed to. For example, if the field "vcg" was identified at step **510**, then at step **520**, the device to be modified is identified, such as "mdvc-1001" and what the vcg field should be changed to for the device is identified, such as "vcge3".

The method **500** then proceeds to step **525**. At step **525**, the skeleton script generated at step **515** is populated with the data from the input file generated at step **520**

to create a finalized script. The method then proceeds to step **530**.

At step **530**, the finalized script is run by the command handler application program to update the database. The method then ends at step **599**.

An example illustrating method **500** may be described as follows. Suppose a user needs to update the vcg field for a number of cellular devices. At step **510**, the user inputs the field name "vcg" into the update application program. At step **515**, a skeleton script is generated to update a vcg field. For example, the update application program may generate the following skeleton script:

Blodi:dev=__________;

Mtcgc:dev=________, vcg=_______;

Blode:dev=____________;

The Blodi and Blode commands are used to block and unblock a device. The Mtcgc command is used to identify a device for which the vcg field needs changing and the vcg command is used to change the value of the vcg field. The blanks indicate portions of the skeleton script which are populated as described below. Note that the user simply enters "vcg" into the update application program and it is able to generate the skeleton script described above.

At step **520**, the user generates an input file including the device that is to be changed and what the value of the identified field is to be changed to as shown below:

mdvc-1001 vcge3

mdvc-2001 vcge4

....

END

In this example the user wants to change the vcg field for mdvc-1001 to vcge3 and the vcg field of mdvc-2001 to vcge4 and so on. Thus, the user simply enters the device and the values that they want the field changed to for the device.

At step **525**, the skeleton script generated at step **515** is populated with the data from the input file generated at step **520** to create a finalized script as illustrated below:

```
Blodi:dev=mdvc-1001;
Mtcgc:dev=mdvc-1001, vcg=vcge3;
Blode:dev=mdvc-1001;
Blodi:dev=mdvc-2001;
Mtcgc:dev=mdvc-2001, vcg=vcge4;
Blode:dev=mdvc-2001;
………………
END
```

When the finalized script is invoked from the command handler application, the commands are executed one by one and the database is updated at step **530**.

Thus, it should be understood from the foregoing description that, in one embodiment, the present invention automates the update process for cellular site information databases. A user enters the field to be modified, the devices to be modified and what the field should be modified to for a particular device. The present invention, in one embodiment, may populate a skeleton script with the device identifiers and new field values and execute the populated script using a command handler. The database is then updated. The user does not need to remember or know line commands. Also, even experienced line command users avoid input errors because the line commands in the script are automatically generated for the user.

Although the present invention has been described above as implemented in a preferred embodiment, it will be understood that alternative embodiments will become apparent to those skilled in the art to which the present invention pertains without departing from its spirit and scope. Accordingly, the scope of the present invention is defined by the appended claims rather than the foregoing description.